# BONUS MICROPOLL

## Multilevel assessment of microplastics and associated pollutants in the Baltic Sea

Publishable summary report 1
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Project participants
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Kickoff meeting 2017, Rostock, IOW

First year meeting 2018, Kristineberg, IVL



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## Project overview, goals, and expected results

The project focuses on the multilevel impacts of microplastics (MP) themselves, of associated pollutants and of attached biofilms on the ecosystem Baltic Sea. Besides detecting the status of MP in the Baltic Sea (abundance, composition, sources, sinks), the project explores the vector function of MP as well as the impact of MP on Baltic biota. The gathered data will enable us to create spatio-temporal scenarios and simulations for MP transfer and circulation, which will help to understand the mitigation processes of MP and associated pollutants/biofilms in the Baltic Sea. We aim at developing indicators and suggesting monitoring strategies regarding MP and associated pollutants, this way contributing to the implementation of the Marine Strategy Framework Directive. Another part of the project is the evaluation of several MP avoidance measures and the testing of efficient wastewater treatment technologies. Overall, the project will serve as a solid framework for the implementation of source and impact prevention aimed measures for the reduction of plastics pollution in the marine environment.

## Project year 1: Work performed and main results

Work package 1: Sampling and processing

Sampling took place on the water surface, in the water column, and on Baltic beaches. Further samples, esp. sediment, were available from pre-project sampling campaigns. The majority of sampling activities within this work package is largely completed and will be finalized by the end of 2018. Analysis of collected samples has already started. 130 of approx. 170 beach samples around the whole Baltic Sea were already taken, comprising all different size classes of plastic (micro, meso and macro). This definition of size classes serves as the basis for later proxy analysis for the indicators and thresholds (work package 6). The sample processing and analysis procedures were optimized to allow for a clean, detailed and time-efficient analysis of large numbers of particles per sample. A dedicated cleanroom was set up in order to avoid contamination by MP from the lab environment when MP are filtered and fractionated onto silicon substrates. Two Raman- and one FTIR-microscope are currently tuned for the semi-automatic analysis of several thousands of particles per filter. Automatic particle detection, measurement, and evaluation heavily reduces the required analysis time, which is key for being able to process all samples within the project.

Tools for beach sampling (photo: V. Sabaliauskaite, KU)

A Marine Plastic Database (MPDB) was developed. The MPDB is a database for all data collected within the project. It allows general import/export and data exchange with other international and national Marine Litter databases (e.g., German Baltic Marine Litter database) and provides tools for data quality insurance and assessment, spatial visualization, and statistical analysis. The database is developed using Structured Query Language (SQL) as a widely spread and well-documented language with the necessary flexibility of storing data.

Work package 2: Vector function of MP

An incubation experiment to investigate the vector function of MP for microorganisms and pollutants was prepared in the first reporting period. A test incubation was carried out. Material to be incubated in seawater was chosen, as were the different groups of compounds, which will be analysed besides the developing biofilms. Microbial communities associated with plastic particles from across the whole Baltic Sea and their corresponding water communities were extracted, sequenced, and will be analysed later in 2018. A first glimpse of the data revealed differences between communities on MP and in the water.

Work package 3: Impact on Baltic biota

The key focus in the reporting period was the creation of solid experimental protocols and test systems required for the experiments, analyses and models to come. Some experimental work has also been conducted. Two MSc Theses and one BSc Thesis have been produced as a part of research and education activities. The scientific results and output are starting to accumulate and getting published



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(e.g., Ogonowski *et al*., 2018, *What we know and what we think we know about microplastic effects – A critical perspective*). The collected data are also being used to inform stakeholders and the public at numerous occasions.

Work package 4: Efficient wastewater treatment

The MP-discharge quantification indicate a considerable discharge of MP to the Baltic Sea from waste water treatment plants (WWTPs). Despite relatively good removal efficiency in existing facilities (in average 94%), this is due to the extreme water quantity treated in today's WWTPs. While Poland, Russia and Sweden are the countries with the largest wastewater discharge to the Baltic and account for the highest MP-discharges, Latvia, Russia and Poland are the countries that have the highest amount of MP-discharge per discharged wastewater unit. This is most likely explained by the less efficient MP-removal in these counties.
Sanitary sewer overflows (SSO) are currently neglected as source of MP; however, results from this work package indicate a significant contribution of different SSO events to the total MP-discharge to the Baltic Sea; in some cases with more than 50%. These results stress that SSO and WWTPs discharges are highly important transport routes for MP from the urban environment and need to be addressed.

Work package 5: Modelling, sources, transport, fate

A thorough literature survey has been performed to quantify present-day MP emissions to the Baltic Sea and provide an explicit spatial distribution of these. Two approaches were used for these. The first one was the population density approach (Jong et al. 2010, Leberton et al. 2012) which uses population size of cities and river catchments as predictor for MP emissions. The resulting dataset has been completed. The second approach is a more mechanistic one and takes individual sources of MP into account, including harbours, beaches, shipping routes, and large wastewater treatment plants. While most of the data have been gathered during the first year of the project, the completion of this second approach is still ongoing. The second approach will be the base for the emission scenarios, and exchange within the project has been going on to decide on realistic scenarios. Both the present-day and the future emission scenarios will serve as input for the MP transport model in year 2. Validation of the model will be done using the data on MP abundances gathered in the course of the project.

Work package 6: Policy advice and implementation

Already gained knowledge of the different necessary working steps from sampling until processing will lead to precise cost calculations for different monitoring methods. A training video of the different beach monitoring methods is available online: *https://www.io-warnemuende.de/plastic-sampling-7130.html*. The german national working-group on the implementation of the Marine Strategy Framework Directive is updated about the project progress regularly. An intensive literature survey (28 studies; 1962-2017) was performed on effects of particle suspensions (MP, mixed sediment, specific minerals). A survey considering the 'Program of Measures to tackle the microplastic pollution' was performed. In terms of further avoidance measures an evaluation of the success of cigarette butts remediation measures was done. Based on an internal survey (of all project partners) in 2017, it was agreed that citizen science activities are already ongoing in all partner countries and will be performed independently. These awareness raising and educational activities are closely related with dissemination activities in work package 7.

Work package 7: Management, coordination, dissemination

Within the first project months, a communication & dissemination plan as well as the project website (*https://www.io-warnemuende.de/micropoll-home.html*) were established. The work of all project partners is closely connected, and communication and exchange plays an important role in the project. This was facilitated via two project meetings (July 2017, May 2018), one video conference (January 2018), and several smaller meetings. The transfer of the project results is ensured by scientific publications, close exchange with related projects, and the participation of several project partners in stakeholder committees. The high number of interviews (17), multi-media products (2), outreach initiatives (30), and popular science papers (4) originating from the project highlight the excellent communication and dissemination of the project results to stakeholders and the public.



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